

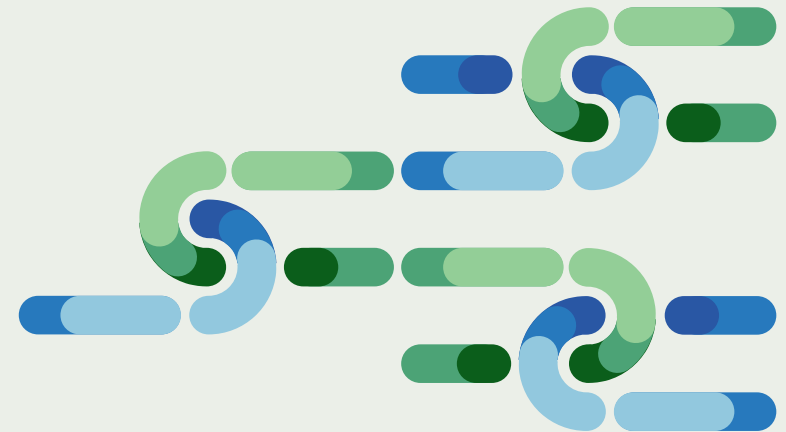
Technical proposals for implementing GBI connectivity networks in spatial plans and sector instruments

Pilot area: Caorle Wetland Lagoon System

Reference in AF: D2.5.1 including outcomes of D2.2.1, D2.2.2, D2.3.1, D2.4.1

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Case Studies 4th step: Draft a technical proposal integrating the project for a GBI connectivity network into planning tools/sector plans in pilot areas. A2.2, A2.3 and A2.4 deliverables are parts of it.

Technical proposals for implementing GBI connectivity networks in spatial plans and sector instruments

Pilot site: Caorle Lagoon Wetland System

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Venezia, April 2025

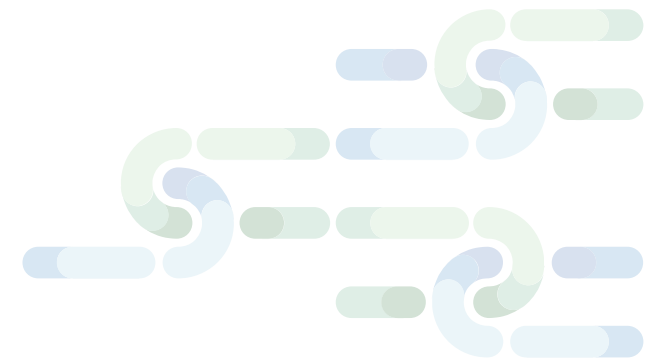
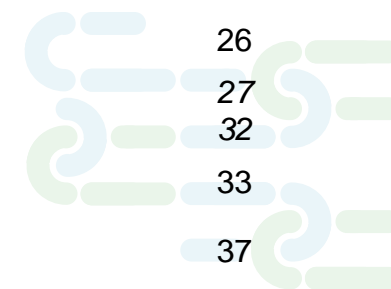


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Glossary

Wetland

A wetland area is a marshy area which, due to its size, morphological instability and nature, is able to provide a stable and lasting habitat for water birds. Conversely, areas that are not likely to provide habitats for waterfowl due to their size or instability are excluded from this definition (see chapter 2 of the Circular applying EU Commission Regulation 2021/57 of 21 January 2021, Ministry of the Environment, 09/02/2023).

Ecological connectivity

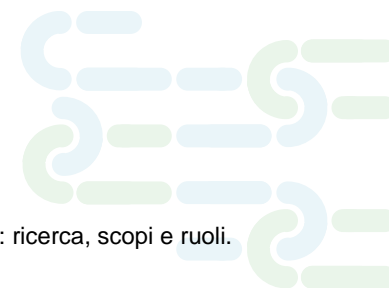
The term starts from the degree to which an element of the landscape can facilitate or not the movement of organisms within a territory. The ecological connectivity approach can be functional, i.e. specifically aimed at one or more species, or structural, which focuses on the physical form of the territory. For spatial planning purposes, a structural approach for the definition of ecological connectivity, including the spatial dimension, is more appropriate (Glossary of the “PlanToConnect” project). It should also be specified that in ecosystem systems there is a very close link between structure and functions: “the functions of yesterday have determined the structure of today, the structure of today determines the functions of today, the functions of today determine the structure of tomorrow” (Forman and Godron, 1989, Gibelli, 2002¹). The articulation of heterogeneous spaces induced by spatial planning must therefore be organized in such a way as to guarantee the needs of the functions and processes underlying ecological networks.

Ecological network

The ecological network is an interconnected system of habitats, whose biodiversity must be safeguarded, paying attention to potentially threatened animal and plant species. Working on the ecological network means creating and/or strengthening a system of connection and interchange between isolated areas and natural elements, thus counteracting fragmentation and its negative effects on biodiversity (ISPRA, “What is an ecological network”).

¹ Forman, R.T.T. & Godron, M. 1986. *Landscape ecology*. John Wiley, New York.

Gibelli, M.G. 2002. *I principi dell'ecologia del paesaggio applicabili alla pianificazione territoriale*, in: Gibelli-Santolini, 10 anni di Ecologia del paesaggio in Italia: ricerca, scopi e ruoli. Copyright © SIEP-IALE 2002, ISBN 88-900865-1-3



Ecosystem services

The concept of Ecosystem Services was first put forward by Robert Costanza, professor in ecological economics, in 1990 (Costanza, R., Perrings, C., 1990. *A flexible assurance bonding system for improved environmental management*. Ecol. Econ. 2, 57–76.) Since then, concepts and methods have developed all over the world, taking on different declinations.

The concept stems from the maturation of awareness of the fundamental importance of ecosystems in sustaining human life, activities and well-being. Research has focused on better understanding the relationship between ecosystem functions and the benefits provided, to the point of estimating their economic value. Hence the concept of Natural Capital.

Although there are several classifications of such services in the literature (e.g., CICES, IPBES, TEEB), one of the most influential reports in the field, the *Millennium Ecosystem Assessment* (MEA, 2005), defines ecosystem services as “the multiple benefits provided by ecosystems to humankind” and distinguishes them into four broad categories, all of which are closely related to the well-being and health of humankind:

- **Production services:** these are represented by all goods, produced or derived from ecosystems useful to man to satisfy his material needs. This category includes, for example, food, timber, fibres in general and drinking water.
- **Regulatory services:** they are an expression of the priority functions of a territory, since the proper functioning of the entire ecological system and therefore the supply of all other ES depend on them. They provide benefits such as, for example, water purification and waste treatment, pollination and regulation of air quality, climate, erosion, natural hazards, etc.
- **Cultural services:** these are services that have in common the peculiarity of being intangible, i.e. not tangible. This includes services that contribute to human spiritual well-being, such as educational, aesthetic, cultural diversity, recreation, and ecotourism values.
- **Support services:** These services include, for example, nutrient cycling, soil formation, primary production, photosynthesis, the water cycle and habitats for biodiversity. They enable the provision of all other types of ecosystem services. From this it can be deduced that these are not separate categories: support services are in fact a transversal category that flows into the others and feeds them, constituting in fact a prerequisite for the production of all other ecosystem services.

The most widespread and recent classification of ecosystem services is The Common International Classification of Ecosystem Services (CICES), which identifies only three main categories: 1) supply or supply services (i.e., food, drinking water, biotic and abiotic materials used for the production of goods, abiotic and biotic renewable energy sources); 2) maintenance and regulation services (i.e., waste

remediation, regulation of flows, the physical environment and the biotic environment); 3) cultural and social services (i.e., symbolic, intellectual and experiential).

Support Services have been eliminated from the classification, not because they do not exist, but as the basis of survival and, therefore, of the possibility of providing all the others, belonging to the totality of Natural Capital.



Executive summary

The concept of ecological connectivity is a fundamental tool for the protection of biodiversity, yet it is not adequately developed and included in the spatial planning systems of the Alpine territory. Existing protected areas have been created to maintain biodiversity and ecosystem functions, but to be effective they must be linked together in a multipurpose and multifunctional ecological network project of green and blue infrastructure through “areas other than protected, dedicated to the conservation and restoration of connectivity”, which allow the migration of species and the resilience of ecosystems in a context of adaptation to climate change.

Until these ecological connection zones outside the protected areas are identified, designed, implemented and managed in a coherent and congruent manner by the countries of the Alpine arc, the ecological network projects are threatened by the effects of human activities, anthropogenic infrastructures and climate change.

The Caorle wetland system chosen as the pilot area has a very high ecological articulation, which translates into a landscape heterogeneity and specific diversity, among the highest along the regions included in the Alpine space.

The case study has developed a project for a Green and Blue Infrastructure (GBI) Network in the Pilot Area, based on an in-depth analysis of territorial vulnerabilities, the mapping of green and blue infrastructures and related priority ecosystem services that need to be re-balanced or reinforced in connectivity conservation and restoration areas. In the second phase, pressures and threats to ecological connectivity were identified, along with areas for conservation and restoration within the planned network.

These studies have served as a reference point to evaluate and propose an alignment of current Ecological Network in the municipal urban plans of the three municipalities of the pilot area Caorle, Concordia Sagittaria and San Michele al Tagliamento. To support the harmonized implementation of ecological networks across municipal boundaries within the Pilot Area, the technical proposal focuses on the following actions: the prioritization of ecological corridors based on their regional and transregional value for connectivity; the adoption of consistent and harmonized terminology and descriptions for all Ecological Network elements across the three municipalities; and the revision of related technical norms and regulations to support effective implementation.

As demonstrated by the case study, although the current planning framework of the Veneto Region includes ecological network plans (e.g., RER and REP), these instruments do not yet fully reflect the functional role of Green and Blue Infrastructure (GBI) nor systematically integrate Ecosystem Services (ES). In light of the ongoing and forthcoming legislative initiatives being led by the Department of Territorial Planning, there is a timely opportunity to advance the current ecological network planning framework. In particular, the upcoming revision of the regional law on Territorial and Landscape Planning foresees the development of thematic guidelines – the so-called “Planning Workbooks” – which offer a promising tool to operationalize these concepts. These workbooks could assist municipalities and provinces in aligning EN plans with GBI ecological objectives at Regional and transnational level, ensuring coherence across governance levels and spatial scales.

Technical proposals for implementing GBI connectivity networks in spatial plans and sector instruments in the Caorle Lagoon

Regione Veneto, Studio Gibelli, April 2025

REPORT



1 GBI network project

The pilot area “Caorle Lagoon Wetland System” is in the eastern part of Regione Veneto and includes the territories of the municipalities of Caorle, Concordia Sagittaria and San Michele al Tagliamento.

The pilot area is located near the eastern border of the region, not far from the lagoon of Marano in Friuli and the lagoon of Venice, Averso valley, both wetlands of international importance under the Ramsar Convention. It is therefore an area of great importance in the Adriatic lagoon system, not only for its own values, but also for its “position value” in the coastal wetland system. The boundaries of the basin occupied by the lagoon are placed at different altitudes. To the east, the countryside is higher than the areas along the course of the Livenza, creating depressed areas north of Caorle. The riverbeds of the Loncon, Reghena, Lemene and Lugugnana rivers have a good part of their course in a N-SW direction, and then arrange themselves along the coastline in an almost perpendicular way, assuming, when the altitude values tend to attenuate and uniform, a sinuous naturaliform course. The ecological network within the Caorle lagoon is made up of a set of interconnected natural and semi-natural elements that form a mosaic of habitats that are fundamental for the maintenance of biodiversity. In summary, the ecological network of the Caorle lagoon represents a complex system of interdependent habitats that support a rich biodiversity and guarantee the maintenance of the fundamental ecological functions for the entire lagoon ecosystem.

The wetland system is a typical example of how the interaction between man and nature can shape the landscape, influencing the evolution of a territory and determining its environmental and cultural value. Despite having undergone major transformations, the lagoon continues to maintain an essential role for fishing and traditional lagoon fish farming “vallicultura”, as well as being an area of great value for biodiversity and ecosystem conservation. The current challenge is to maintain a balance between human activities and the protection of the lagoon environment, to preserve this unique heritage for future generations (for further description see [D 2.3.1](#)).

It is a coastal wetland that “collects”, through fresh water from the Alps, what happens on the Alpine side and in the catchment area underlying it. The relationships with the two main rivers, the Livenza and the Tagliamento, ecological corridors of regional importance, are among the elements of greatest interest for the PlanToConnect project.

The lagoon system is a fragment of a much larger wetland area, which survived the reclamation of the 60s. The Caorle Lagoon constitutes a unique ecosystem, defined as a biodiversity hotspot, to which important ecological and socio-economic functions are associated. In Veneto, the transitional waters are represented by the Venice lagoon, further south by the Po delta complex and further north by the lagoons of Caorle and Baseleghe. To these are added the countless fishing valleys, i.e. portions of the lagoon in which the influx of fresh and salt water is artificially regulated and within which numerous human activities are carried out, mainly related to the breeding and fishing of mollusks and fish species as well as hunting.

The “Wetland Area Contract of the Caorle Lagoon System” operates in this area: a participatory governance tool that involves public bodies, associations, citizens and local operators with the aim of managing, protecting and enhancing the lagoon environment. Through this

agreement, concrete actions are promoted for the conservation of biodiversity, the sustainable management of natural resources and the improvement of water quality, promoting sustainable development of the territory and the involvement of the local community.

The Veneto-Orientale Water Management Consortium plays a crucial role in the management of the Caorle Lagoon, ensuring water control through drainage systems, water level regulation and hydrogeological risk prevention. This consortium ensures proper management of fresh and brackish water, contributing to the conservation of the lagoon ecosystem and promoting the coexistence of agricultural activities, fishing and biodiversity. In addition, it collaborates in environmental redevelopment and monitoring projects, maintaining a balance between human needs and environmental protection.

As indicated in report D.2.3.1 on the design of the Green and Blue Infrastructure (GBI) for the pilot area, an ecological network is already present within the territorial plans of the three municipalities and has been developed in alignment with the ecological network plans of higher-level authorities (Metropolitan City of Venice and regional territorial plans).

However, there is a need to promote greater consistency between the cartographic representations and regulatory frameworks of these planning tools, and to integrate them with the concepts of natural capital, Green and Blue Infrastructure, multifunctionality, and the priority Ecosystem Services identified for the study area — particularly in relation to connectivity zones.

To this aim a GBI network project has been developed for the pilot area to promote a new approach to local governance, through the application of ecosystem services, as a tool for greater knowledge, management and monitoring of connectivity areas. The strategy of integrating ecosystem services into planning tools wants, in fact, to orient design approaches towards a reversal of current and traditional processes, also induced by existing evaluation procedures, towards a proactive orientation, in which natural capital becomes a key reference in the planning landscape, as a recognized resource, with multiple values.

The GBI network project is made up of a set of interconnected natural and semi-natural elements that form a mosaic of habitats that support a rich biodiversity and guarantee the maintenance of the fundamental ecological functions for the entire lagoon ecosystem. Considering territorial specificities and vulnerabilities a set of priority ecosystem services has been selected and mapped in connectivity conservation and restoration areas to identify the typologies of GBIs that needs to be improved or deployed to provide both for biodiversity and climate resilience. The following priority ES has been mapped:

- Habitat quality
- Water purification
- Protection from extreme events
- Regulation of the CO₂ cycle
- Microclimate regulation
- Regulation of the water cycle



- Forest production
- Agricultural production
- Fishery production

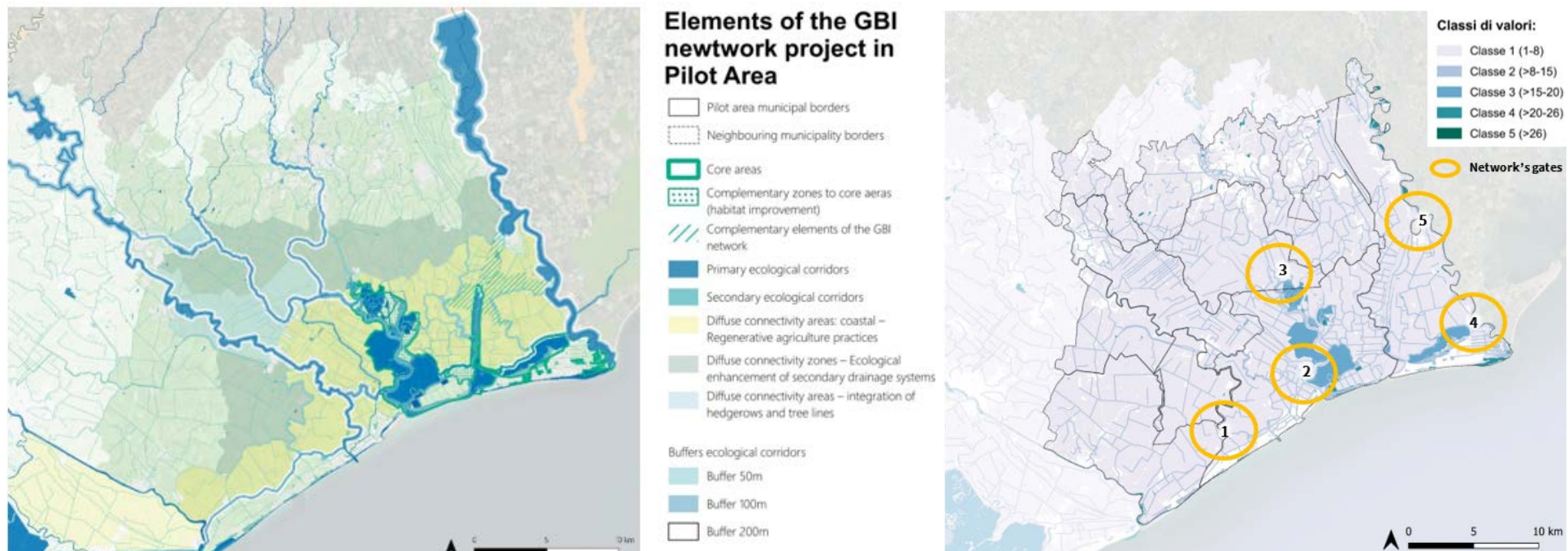


Figure 1 Elements of the GBI network plan and Gates to be kept open and functional of the Caorle Lagoon Wetland System

Based on the analysis of the results of the overlay of the listed priority ES the Elements of the GBI network and the critical nodes to be kept open and functional has been defined. Connectivity measures has been then defined on the base of the typology of GBI (land cover class) present or to be deployed in the connectivity element (see fig. 1).

2 Pressures and Threats to connectivity conservation and restoration areas

This chapter summarizes key outcomes of the more in depth study on pressure and threats to connectivity in pilot area (see report 2.4.1).

2.1 Main pressures

The ecological network within the Caorle lagoon is made up of a set of interconnected natural and semi-natural elements that form a mosaic of habitats that are fundamental for the maintenance of biodiversity. Main pressures leading to the direct degradation of habitat connectivity functions in corridors includes:

- agricultural and fishing practices: the main vulnerabilities are related to the property regime, the use of pesticides and fertilizers in agriculture and the burial of the minor hydrographic network in agricultural areas (in favor of underground tubular drainage), water pollution (with respect to chemical-physical alterations, eutrophication, organic compounds for agriculture, metals, civil and industrial discharges), the alteration of the structure of watercourses (catchment and regulation of waters that can cause changes in the flow regime, construction of works that prevent the passage of fish fauna, poor management and hydraulic maintenance of riparian environments, riverbeds and banks, erosion phenomena), to changes in agricultural practices;
- pressures on the forest present in the area (of different origins, i.e. anthropogenic, such as Valle Vecchia and Bibione, and natural, such as Foce del Tagliamento, Valli Grandi di Bibione): active silvicultural management is necessary aimed at increasing the biodiversity of forest coenosis;
- Tourist pressure. There are impacts along the coast due to the use and expansion of settlements and infrastructures already developed as a result of the growing seaside tourist activities, with the conversion of beaches and dunes, the interruption of spontaneous dune dynamics and the very strong building expansion in correspondence with the major seaside resorts; the increase in the uncontrolled abandonment of waste (especially plastic); The exceeding of the carrying capacity within the protected area of Brussa beach.
- Pressures on the deep and surface water system: agglomerations, discharges (civil and industrial) and purifiers, waste management plants, polluting loads of agro-livestock origin,
- Climate change pressures: rising of the sea level, draught periods and seawater intrusion, coastline change and erosion

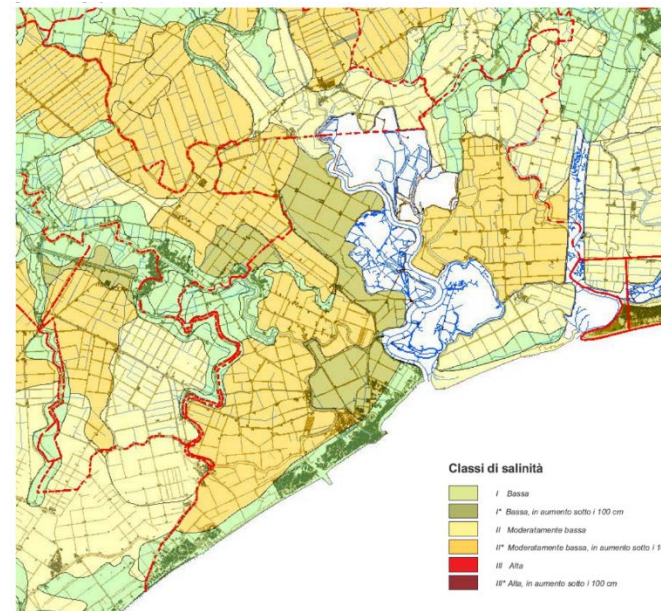


Figure 2 Coastline change and Soil salinity classes (source: Città metropolitana di Venezia)



2.2 Threats to connectivity conservation and restoration areas

The pilot area is subject to several potential threats to connectivity that can be identified and summarized as follows:

- Infrastructure developments that fragment the territory: The existing infrastructure network is already sufficiently widespread, but the PTRC provides for further lines of upgrading towards the coast (figure 5), from the area between the coastal strip to the south and the infrastructural arteries that run along the line, which divides the historically consolidated territory from the more recent reclamation to the north, the settlement and related service system is currently quite limited and the planned expansions rather concentrated, although some trend lines identified by the PAT could increase the level of interference with areas of naturalistic value;
- The abandonment of traditional agricultural and fishing activities, with modification of existing agroecosystems and fish habitats, could make their balances more fragile, as well as causing the loss of the consolidated landscapes present, which could lead to the loss of identity of the places concerned, a further driving force of degradation of socio-economic derivation typically found in stalemate situations;
- Changes in the morphology of the territory due to the natural evolution of the lagoon system and the mouths of the rivers that converge on it,
- Hydrogeological risk prevention and related safety interventions (that if implemented with Nature Based Solution may have a positive effect on habitat preservation nevertheless this is not the majority of cases in pilot area)



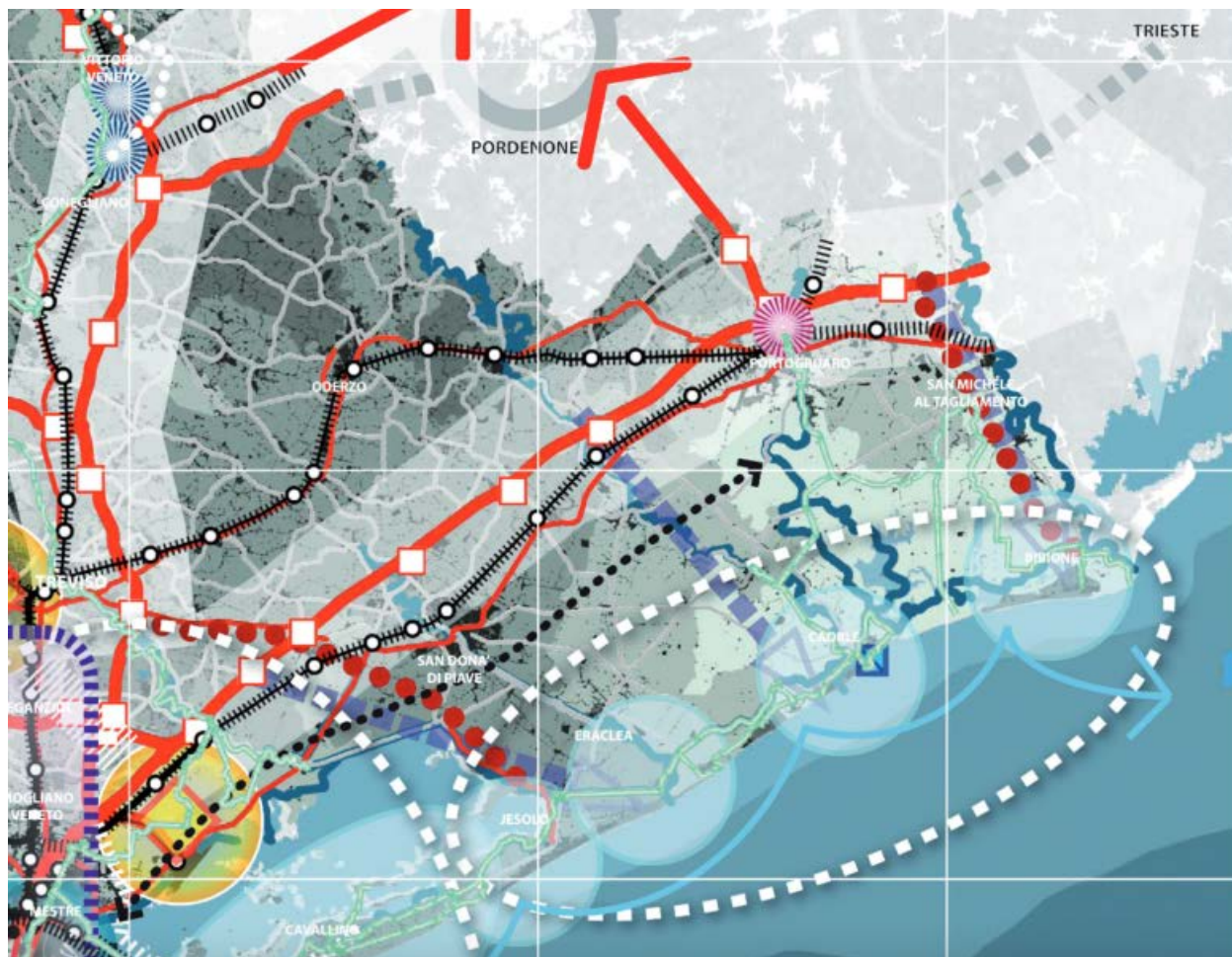


Figure 3 Infrastructural projects interfering with the Caorle lagoon system foreseen by the Regional Territorial development Plan



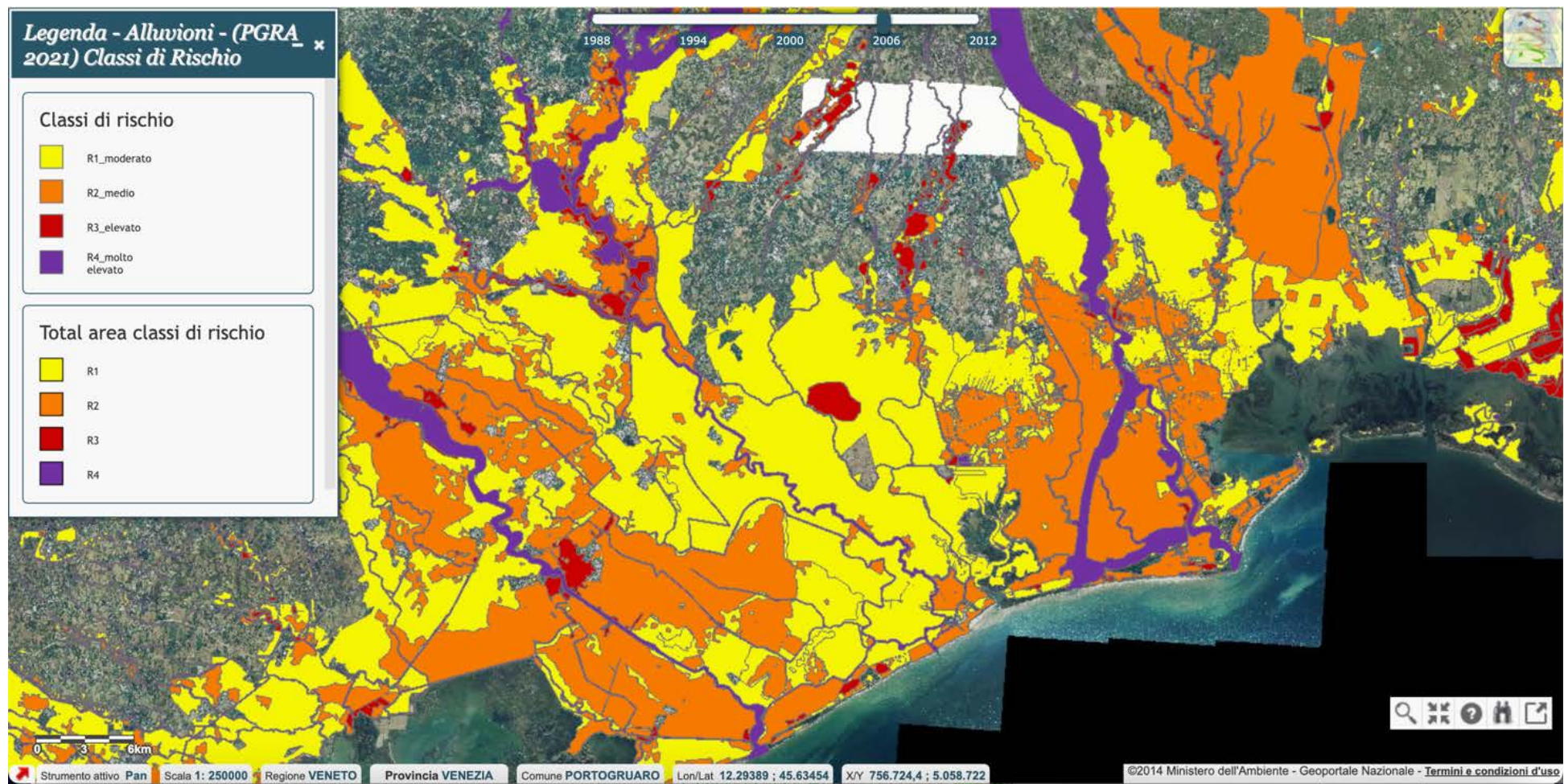


Figure 4 Hydrogeological risk areas (source: Geopoortale nazionale)

3 Connectivity measures and governance settings

3.1 Connectivity measures/action plan

Based on the GBI project, the following proposals for key connectivity measures have been developed and proposed as integration to the action plan of the Caorle lagoon Wetland Area Contract (see paragraph 3.2):

- **“Litoranea veneta” corridor:** The Litoranea Veneta project is a strategic initiative aimed at enhancing and revitalizing the historic network of inland waterways that connects Venice to the Isonzo River, crossing lagoons, rivers, and natural landscapes in the eastern Veneto and Friuli Venezia Giulia regions. A series of targeted actions have been developed by PlanToConnect, in agreement with the land reclamation consortium, to enhance the multifunctionality of the Litoranea Veneta, with particular emphasis on its role as a primary ecological corridor. These include the ecological restoration of specific sections of the waterway to improve habitat quality and the delivery of ecosystem services
- **“Cavrato” corridor.** In the Caorle Lagoon area, the term **“cavrato”** refers to an **artificial canal or drainage channel** used for water management within the fishing valleys and surrounding wetlands. The **cavrato** is part of the traditional hydraulic system designed to regulate the flow of both brackish and freshwater, ensuring proper environmental and productive management of the fishing areas. Currently, the Cavrato corridor has lost its original function, having been largely reclaimed and converted into a flood relief channel for the Tagliamento River. The land is currently cultivated and used for intensive, low-value agriculture (as it is subject to salinization from the salt wedge and periodic flooding, making it unsuitable for investments). The ideal solution for the proposed action would be the renaturalization/re-flooding of the entire area encompassing the Cavrato corridor, considering the unfavourable conditions for agriculture and the opportunities in terms of ecological connectivity with the Tagliamento River, which is the primary ecological corridor of the IVB Project in the Pilot Area. An alternative solution, less costly but also less effective, proposed by PlanToConnect involves the creation of berms and the implementation of agri-environmental measures in agricultural areas affected by flooding to reduce erosion and sediment transport into the lagoon, while improving habitat quality and diversity (cover crops, no-till seeding, shrub belts with willows along the minor watercourses)
- **Diffuse connectivity areas:** Since the effectiveness of core areas also depends on the degree of “hostility” of the surrounding matrix, to ensure improved ecological functionality of these areas, diffuse connection areas have been proposed. These are predominantly agricultural areas characterized by a high level of ecosystem simplification, where conservation agriculture practices, rehabilitation of minor watercourses, and integration of hedgerows and tree lines should be implemented to enhance biodiversity. The aim is to enhance the ecological permeability of the agricultural matrix by promoting regenerative agriculture measures and

enriching diffuse natural elements through networks of hedgerows, small woodlands, and the restoration of riparian vegetation along the minor hydrographic network.

- **Complementary areas to the ecological network:** These are areas identified in the GBI Project of the Pilot Area as complementary elements and habitat enhancement zones for the core areas. They are adjacent or close to network elements which, although currently lacking high ecological quality, have high ecological potential due to their strategic location and can help expand and consolidate the GBI network plan. Their purpose is to improve the ecological quality and functionality of the entire system. Overall, these are predominantly agricultural areas characterized by a high level of ecosystem simplification, where regenerative agriculture practices, rehabilitation of minor watercourses, and the integration of hedgerows and tree lines should be implemented to increase permeability, biodiversity and ecosystem services.
- **Valli da Pesca.** The "Valli da pesca" in the Caorle Lagoon (in Veneto, Italy) are fenced lagoon areas traditionally managed for extensive fish farming and hunting activities. These zones represent a landscape, ecological, and cultural element of great value. The valli da pesca are enclosed by natural embankments or fences, often with channels for water inflow and outflow, allowing control over the lagoon's water flow and quality. Using sluices or gates, managers regulate the entrance and exit of brackish water, creating a suitable environment for various fish species. This control helps maintain the balance between fresh and saltwater, essential for many species' survival. Unfortunately, only one of the three existing fishponds is still actively used for aquaculture, while the others are mainly used for hunting activities. The abandonment of aquaculture and the related management of water flow has led to a significant reduction in the exchange of water between the different lagoons, with important repercussions on the current tidal dynamics, which are no longer able to effectively cleanse and renew the lagoon waters. The action developed by PlanToConnect consists of a proposal to increase and/or widen the sluices in order to enhance tidal flows, strengthen the connections between the different wetland areas, and improve ecological continuity and the water renewal process driven by the tides, aligning the management criteria with the owners of the "valli" in exchange for compensation.



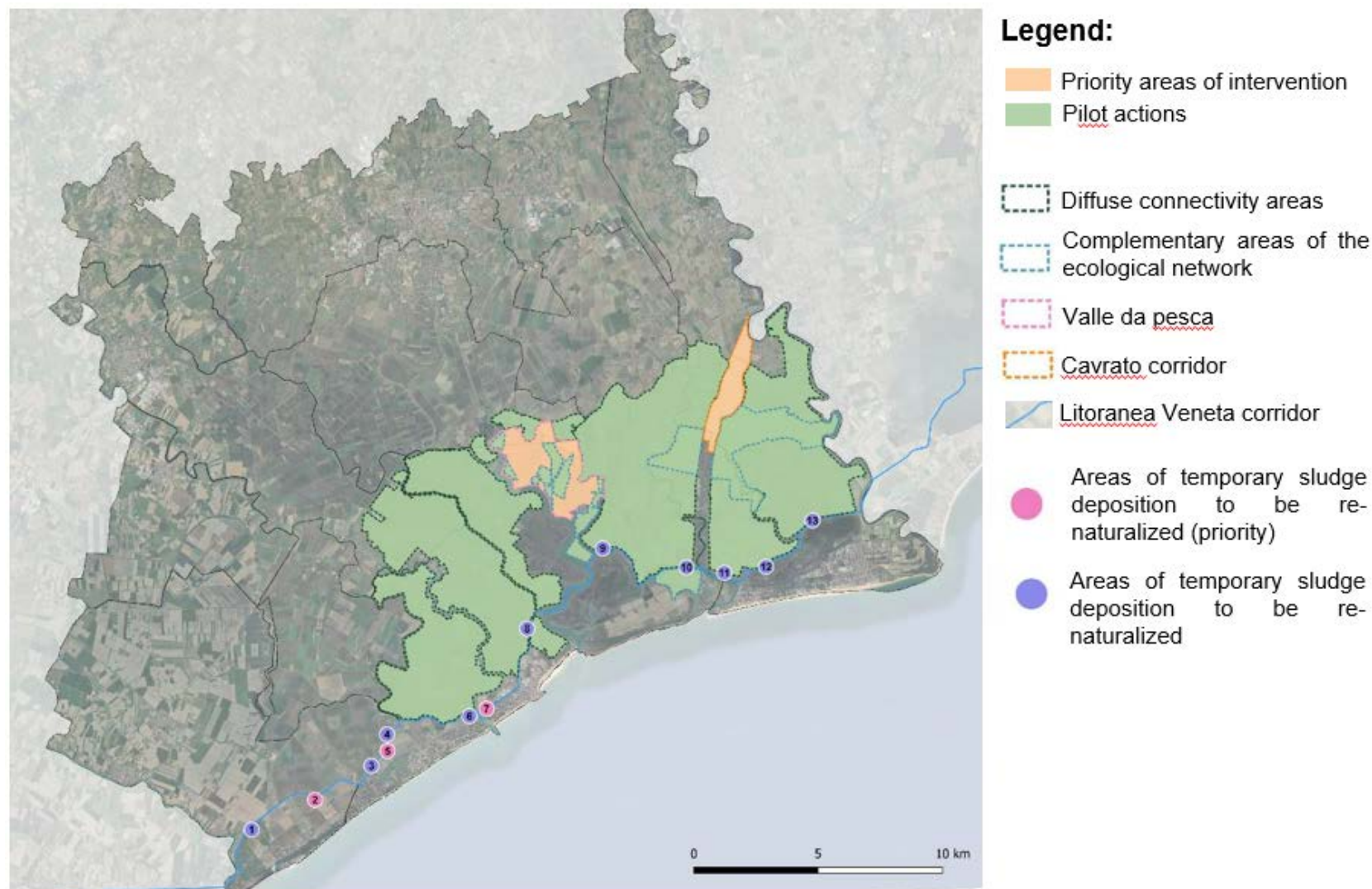


Figure 5 GBI network Project: actions for the implementation of connectivity of the in the pilot area



3.2 Governance settings

The “Wetland Area Contract of the Caorle Lagoon System” operates in this area: a participatory governance tool that involves public bodies, associations, citizens and local operators with the aim of managing, protecting and enhancing the lagoon environment. Through this agreement, concrete actions are promoted for the conservation of biodiversity, the sustainable management of natural resources and the improvement of water quality, promoting sustainable development of the territory and the involvement of the local community.

The Veneto-Orientale Water Management Consortium plays a crucial role in the management of the Caorle Lagoon, ensuring water control through drainage systems, water level regulation and hydrogeological risk prevention. This consortium ensures proper management of fresh and brackish water, contributing to the conservation of the lagoon ecosystem and promoting the coexistence of agricultural activities, fishing and biodiversity. In addition, it collaborates in environmental redevelopment and monitoring projects, maintaining a balance between human needs and environmental protection

Focus of the case study is the adoption of priority corridors in the spatial plans of the pilot area and the development of measures for their implementation under adequate governance settings. To this regard, most of the priority corridors identified in the GBI network designed for the pilot area falls within the territory covered by the Caorle Lagoon Wetland Contract. The Contract aims to find integrated and shared solutions for the protection and enhancement of the natural capital of the territory of the “Caorle Lagoon System”, as indicated in the text “Wetland area contract of the Caorle Lagoon System. A negotiated programming agreement pursuant to art. 2, paragraph 203 letter a) of Law 662/96”.

The priority objectives in managing the Wetland System covered by the Contract include nature conservation (Directive 92/43/EEC “Habitats” and Directive 2009/147/EC “Birds”), hydraulic safety (Directive 2007/60/EC “Floods”), and water quality (Directive 2000/60/EC). These goals are complemented by the protection of the river and lagoon environment and the broader sub-basin territory, with particular attention to biodiversity, ecological value, and ecosystem services. Although ecological connectivity is not explicitly mentioned, the Contract already emphasizes the conservation of natural capital and the protection of biodiversity. As such, no revisions to its aims or commitments are considered necessary and it will be sufficient just to include specific objectives and connectivity measures in the contract’s action plan currently under revision.

All connectivity measures outlined in paragraph 3.1 lie entirely within the three municipalities participating in the contract, except for certain re-naturalization areas along the “Litoranea Veneta” blue corridor. This corridor links the Caorle Lagoon Natura 2000 site with the Mort Lagoon and Venice Lagoon Natura 2000 sites. However, these areas still fall within the Metropolitan City of Venice, and the corridor itself is managed by the Western Veneto Drainage Consortium—both of which are part of the contract.

The following table summarizes the new specific objectives and the connectivity conservation and restoration measures outlined in paragraph 3.1 that will be proposed as integration to the contract’s action plan.

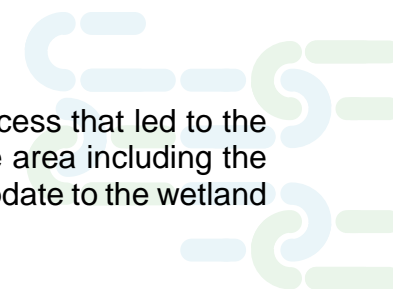
Table 1 Proposals for updating the action plan of the Wetland Area Contract.

Connectivity measure	Description	Promoter	Responsible authority	Stakeholders to be involved in the implementation of the measure.	Financial resources	Proposals for new specific objectives and notes
"Litoranea veneta" corridor	Plantoconnect - Increase the multifunctionality of the "Litoranea Veneta", with particular reference to its role as a primary ecological corridor. Ecological restoration of sections of the waterway to improve biodiversity, permeability and the provision of ecosystem services.	CBVO - Eastern Veneto Reclamation Consortium	"Infrastrutture venete" - In house agency of the Veneto Region	CBVO Veneto region (Infrastrutture venete, environmental and biodiversity departments) Vegal (EU LEADER and FLAG action group) Owners of the lands subject to expropriation for renaturalization interventions	The design of the Litoranea Veneto received a EU contribution through the Poseidone Project (interreg ITA-SLO) and the project is part of the WIN IT program, co-financed by the European Union through the Connecting Europe Facility (CEF)	New specific objective: improve the delivery of ecosystem services related to support and regulation of the water cycle, with particular reference to purification, infiltration, and enhancement of runoff. Ecological restoration of areas designated for the temporary storage of sludge. Reforestation of areas identified in the feasibility study of the CBVO
Corridoio cavrato	Plantoconnect - Mitigate the effects of flooding, reduce erosion and sediment transport into the lagoon, improving the quality and diversity of habitats	Veneto Region	CBVO	CBVO Veneto Region: "Veneto Agricoltura" agency for the innovation in the primary sector, and Directions for hydrological risk prevention and agro-environmental measure Owners of the agricultural lands affected by the overflow channel	Agro-environmental measures	New specific objective: agricultural management of areas affected by flooding to reduce erosion and sediment transport into the lagoon, improving habitat quality and diversity. Hydraulic checks of the planned ridge arrangements.

Diffuse connectivity areas	Plantoconnect - Promote the ecological permeability of the agricultural matrix through regenerative agriculture and the enhancement of widespread natural elements.	Veneto Region	Veneto Agricoltura agricultural enterprises	CBVO Veneto Region: "Veneto Agricoltura" agency for the innovation in the primary sector, and Directions for agro-environmental measure Pilot agricultural companies with properties in the area	Agro-environmental measures	Note: reduce the pressure from intensive agricultural activities by experimenting with regenerative agriculture measures and provide networks of hedges, groves, and riparian vegetation along the minor drainage network
Complementary elements of the ecological network	Plantoconnect - Reconstruction of habitats and enhancement of elements of widespread naturalness to strengthen the ecological connectivity of agricultural areas	Veneto Region	agricultural enterprises	CBVO Veneto Region (dir. biodiversity, agroenvironment) Pilot agricultural enterprises in the area	Agro-environmental measures	New specific objective: renaturalization of sections of the minor watercourse network." Note: "Reduce the pressure from intensive agricultural activities by experimenting with conservation agriculture measures and providing networks of hedges, groves, and riparian vegetation along the minor drainage network.
Valli da pesca (valle zignago)	Plantoconnect - Management of openings to improve water circulation and quality.	Veneto Region	Owners of the valli	CBVO The University of Padova Owners of the valli	LIFE HORIZON	

3.3 Key Stakeholders

Several actors operate within the contract, some of which have been significantly active in the development of the process that led to the signing of the contract itself and in the development of important projects for the conservation and development of the area including the definition of the connectivity measures identified in the framework of the PlanToConnect Case Study and proposed as update to the wetland contract's action plan.



Coordinated by the Western Veneto Drainage Consortium, the contract brings together key stakeholders, including the Veneto Region, the Metropolitan city of Venice, three municipalities, the local development agency, environmental NGOs, interest groups (hunters, agricultural associations, tourist associations) and private landowners.

Among them those to be involved in the proposal of actions for connectivity include:

- Eastern Veneto Reclamation Consortium (CBVO)
- Regional Authorities. In particular the Directions for: Spatial Planning, Biodiversity and parks, environment and ecological transition, hydrological risk prevention, agro-environment, “Veneto Agricoltura” (the in-house agency for the innovation in the primary sector) and “Infrastrutture Venete” (the in house company responsible for planning and management of strategic infrastructures including transport network, hydraulic engineering and environmental infrastructure)
- Vegal (EU LEADER and FLAG action group)
- Agricultural associations
- Owners of the lands subject to expropriation for renaturalization interventions
- The Metropolitan City of Venice
- The Municipalities of Caorle, San Michele and Concordia Sagittaria

The active involvement of agricultural enterprises in regenerative agricultural practices is essential for the effective implementation of the connectivity plan. For long-term sustainability, such efforts cannot rely solely on EU public funding mechanisms, such as agri-environmental schemes. Instead, they require the proactive engagement of agricultural businesses operating in the area, through the adoption of robust Environmental, Social, and Governance (ESG) strategies and the establishment of innovative public-private partnerships (PPPs).

With the support of Veneto Agricoltura, RV held two meetings with Italian representatives of the “LENs – Landscape Enterprise Networks” North-East Italy program to promote the participation of farms in the GBI network buffer zones in the call for agricultural enterprises launching in April 2025. Operated by Preferred by Nature and supported by Nestlé Purina and the Consorzio Tutela Prosecco DOC, LENs brings together key stakeholders to foster an ecosystem supporting regenerative agriculture in Veneto and Friuli Venezia Giulia. In 2024, 57 farms and landscape enterprises were involved, including several in the pilot area. Veneto Agricoltura, a LENs partner since 2021, contributed to the program’s development and to drafting technical guidelines for the calls. However, due to disagreements over the adoption of key technical aspects in the upcoming call, the agency has withdrawn from the initiative. RV will continue its efforts to re-establish a fruitful partnership as well as explore alternative ways to engage farms in the pilot area. (see website <https://landscapeenterprisenetworks.com/lens-locations/italia-italiano/> and <https://youtu.be/2weJ0E0TyMc?si=0msd5sDjK7DQJSe6> and <https://youtu.be/7j0tPIYrw6o>).

Technical proposals for implementing GBI connectivity networks in spatial plans and sector instruments in the Caorle Lagoon

Regione Veneto, Studio Gibelli, April 2025

3.4 Funding instruments

There are several EU funding and national funding sources relevant for financing projects focusing on biodiversity and nature protection provides support for projects that promote sustainable spatial development and ecological connectivity. This includes funding for green infrastructure, habitat restoration, and biodiversity conservation projects and cross border cooperation. Additional types of funding instruments include international (other than EU) funding, and innovative funding sources, which may be used both in national and international contexts.

National, Regional and Provincial funding may take various forms, including aid dedicated to environmental programmes and funds, support to afforestation and land management programmes, funding provided by regional and municipal governments, by non-governmental organisations and foundations or even donors. National-level funding is also needed to complement EU funding, which may provide up to 100 % of funding for individual projects (this is the case for most forest-related interventions under the CAP).

Innovative funding sources relevant to biodiversity and connectivity include primarily financial incentives, sustainable land management practices, green bonds and crowdfunding:

- Payments for Ecosystem Services (PES), which are a potential method to conservation and sustainable resource management because they provide financial incentives for the supply of ecological services. By integrating economic and environmental goals, PES can help to conserve biodiversity, mitigate climate change, and promote sustainable development. To ensure long-term and meaningful results, successful implementation necessitates thorough planning, consistent funding, good monitoring, and fair participation.
- Carbon farming, is a whole farm strategy to improving carbon capture on functional landscapes which refers to a set of land management practices that enhance the uptake and storage of CO₂ in plant matter and/or soil organic matter. This PES-like funding source is regarded as essential for the efforts to mitigate the effects of climate change, improve soil quality, and diversify farmer's income.
- Crowdfunding platforms and Corporate Environmental Social and Governance policies (ESG). Through these innovative tools conservation and renaturation projects can mobilize resources and community support to enhance ecological connectivity, contributing to the overall health and resilience of ecosystems. Example to this regard are the WoW Nature platform of ETIFOR supporting reforestation projects as well as the protection of existing forests companies can mitigate their environmental impacts, activate forms of corporate social responsibility for their employees and integrate reforestation and conservation projects into their environmental, social, and corporate governance policies (ESG policies).

As part of the case study, for each of the connectivity measures proposed for the integration of the contract's action plan, an analysis of the most appropriate instruments was carried out. The results are presented in the following table:

Table 2 - Financial instruments for funding the connectivity actions proposed for the contract action plan

Financial instrument			Usefulness of the tool based on the intervention phase		Applicability of the tool		Priority actions for ecological connectivity				
			Start-up phase (design and implementation)	Maintenance phase	Potential	Critical issues / Barriers	Litoranea veneta corridor	Cavrato corridor	Diffuse connectivity areas	Complementary elements EN	Valli da pesca
Direct EU public contributions	LIFE Nature and Biodiversity		X		Awareness – Development of pilot projects	Does not ensure long-term support	X	X	X	X	X
	HORIZON							X	X	X	X
Indirect EU public contribution	CAP - Agro-climatic-environmental payments	SRA03 – Reduced soil tillage techniques	X	X	Agronomic management supporting ecosystems and biodiversity			X	X	X	
		SRA06 – Cover crops						X			
		SRA07 – Conversion of arable land to grasslands and pastures							X	X	
		SRA08 – Sustainable management of permanent grasslands and pastures							X	X	
		SRA10 – Active management of ecological infrastructures					X	X	X	X	
		SRA19 – Reduction in the use of plant protection products						X	X	X	
		SRA20 – Sustainable use of nutrients						X			
		SRA28 – Support for the maintenance of afforestation and related systems agroforestali					X	X			
		SRA29 – Payment for adopting and maintaining organic production practices and methods						X	X	X	
Fiscal instruments	Integrated water service tariff		X	X	NBS for stormwater management (SuDS) and water protection areas	Approach still little known by public authorities and professionals			X	X	
	Irrigation contribution (payment to land reclamation and irrigation consortia)			X	NBS for diffuse pollution management / River restoration of irrigation canals / Flood management	Approach little known by consortia and professionals, to be explored	X	X			X
	State property concession fees		X	X	ERC internalization / Ecosystem restoration	Lack of earmarking of revenue	X	X			
	Water abstraction concession fees		X	X	ERC internalization / Ecosystem restoration	Lack of earmarking of revenue					X
Market-based instruments.	Biodiversity credits			X	ES provision	Reference practices not yet available	X		X	X	
	PES - Payments for Ecosystem Services			X	ES provision	Limited awareness of the tool	X	X			X

4 Proposals for the implementation of the GBI network plan into spatial and sector planning tools

4.1 State of art of connectivity planning and implementation in the pilot area

The pilot area chosen by the Veneto Region as a case study currently includes the territories of the municipalities of Caorle, Concordia Sagittaria, and San Michele al Tagliamento. All have an Ecological network plan as part of current spatial plans - with some differences among them - guidelines, directives, and specific actions are foreseen for core areas and ecological corridors, integrating them with the regulations for areas of naturalistic connection areas (buffer zones), biotopes, buffer strips and resurgence areas, as well as stepping stones, secondary corridors, gates and barriers. The PAT of the Municipality of Concordia Sagittaria also identifies areas for the establishment of parks and nature reserves of municipal interest.

Although Ecological Network plans are part of current spatial plans, some inconsistencies exist between planning levels and among EN projects of different municipalities. There is a lack of prioritization of connectivity areas within the transnational and regional network design.

Some of the strategic connectivity elements identified in the GBI project resulting from the case study are absent from current ecological network plans, while others have been inaccurately identified. Moreover, technical regulations and implementation guidelines for connectivity areas are insufficient or lacking, and coordination with sectoral instruments and policies is limited or absent. Sector-specific regulations governing land use and land/water management within connectivity areas, as well as the provisions of impact assessment processes, also require better coordination or enhancement.

4.2 Key spatial and urban planning instruments addressed in pilot area

In the following table the Key spatial planning instruments in pilot area addressed by the technical proposal are listed and described.



Table 3: Overview of spatial planning instruments addressed and summary of technical proposals

Instrument	Mandatory/ Voluntary	Relevance for connectivity in pilot area. Gaps or inconsistency	Technical proposal to implement GBIs and ESs and content
Municipal Territorial Spatial Plans (PAT)	mandatory	The PATs map and define the elements of the municipal EN, including connectivity areas, regulating them through technical regulations. Sometimes inconsistencies exist both between different planning levels and in the configuration of the ecological network among different municipalities. Furthermore, the technical regulations provide limited guidance, and implementation is often insufficient or remains merely formal.	Proposal to the PATs of the three municipalities in the pilot area to: <ul style="list-style-type: none"> - enhance the current design of the EN and GBI through the adoption of physical and ES mapping of GBI (selected land cover classes); - harmonize the design approaches and incorporate specific implementation tools; - prioritize corridors according to their relevance and strategic importance at regional, transalpine, and transnational levels; - reinforce the related technical regulations accordingly.
Municipal Implementation Plan (PI)	mandatory	The PIs translate the general regulatory framework - including assets, constraints, provisions, directives, and guidelines - and strategies of the PAT into concrete interventions, including zoning regulations, building codes, infrastructure projects, and urban regeneration initiatives. However, the implementation of the EN and GBI is often insufficient or lacking.	The proposal to the PATs of the municipalities in the pilot area could be implemented within the PIs through ES compensation mechanisms and PES schemes to support the development of multifunctional connectivity measures.

4.2.1 Technical proposal to municipal Spatial Plans in Pilot area

A technical proposal has been developed addressing the Territorial Spatial Plans (PAT) of the three municipalities in pilot area.

PAT is a comprehensive municipal-level planning instrument that defines strategic development directions and governance choices for the local territory. It identifies specific territorial vocations and constraints of geological, geomorphological, hydrogeological, landscape, environmental, historical-monumental, and architectural nature. This is done in alignment with the objectives and guidelines set forth in provincial/metropolitan and regional spatial planning, and in response to the needs of the local community.

The PATs recognize and further develop the elements of the EN established by the higher-level Metropolitan City of Venice Spatial Plan. Technical regulations define specific objectives and actions for each identified element of the EN - primarily directed toward the subordinate

Implementation Plan (PI) - to support the conservation of widespread environmental quality. Additionally, specific provisions are established for territorial areas of environmental significance within agricultural contexts, priority zones for afforestation and naturalization, wooded areas, and infrastructural gates or barriers.

The technical proposal for the municipalities in Pilot Area conceives to improve current Ecological Network (EN) plan to become a cornerstone of adaptive spatial planning, evolving them from a focus on purely permeability or connectivity to addressing ecological key functions of a territory in line with the Green and Blue Infrastructure (GBI) Strategy. PlanToConnect proposes upgrading the EN in pilot areas by adopting the GBI design approach, which integrates biodiversity with the conservation of natural capital and its ecological functions expressed in terms of benefits to humans as Ecosystem Services (ES). The EU strategy positions the EN as a strategic infrastructure for biodiversity conservation, climate change mitigation and adaptation, hydrogeological risk reduction, and the improvement of water and soil quality, as well as supporting cultural and provisioning ecosystem services.

The proposal identifies key supra-municipal GBI and their ES, reduce territorial vulnerabilities by controlling land sealing and use intensity, and connect isolated areas by integrating local and regional networks. It seeks to enhance livability, well-being, environmental quality, address climate-related risks, improve freshwater and agro-ecosystems, and provide a prioritized territorial framework to support the primary objectives of the Caorle Lagoon System Wetland Contract (CdAU) in the valorization and preservation of the natural capital.

In particular it aims to enhance the current design of the EN through the adoption of physical and ES GBI mapping approach, harmonize the design approaches across administrative borders, prioritize corridors according to their relevance and strategic importance at regional, transalpine and transnational levels, reinforce the related technical regulations accordingly.

Regional and transnational connectivity analyses have identified the pilot area as a critical node within the Regional Ecological Network. The main rivers linking the pilot area to the pre-Alpine regions through the urbanized plain, along with the waterways connecting the coastal lagoons, constitute priority ecological corridors at transnational and regional scales. These corridors should be considered as a priority in the harmonization of municipal ecological networks of the pilot area ensuring technical consistency and facilitating coordinated, cross-boundary implementation.



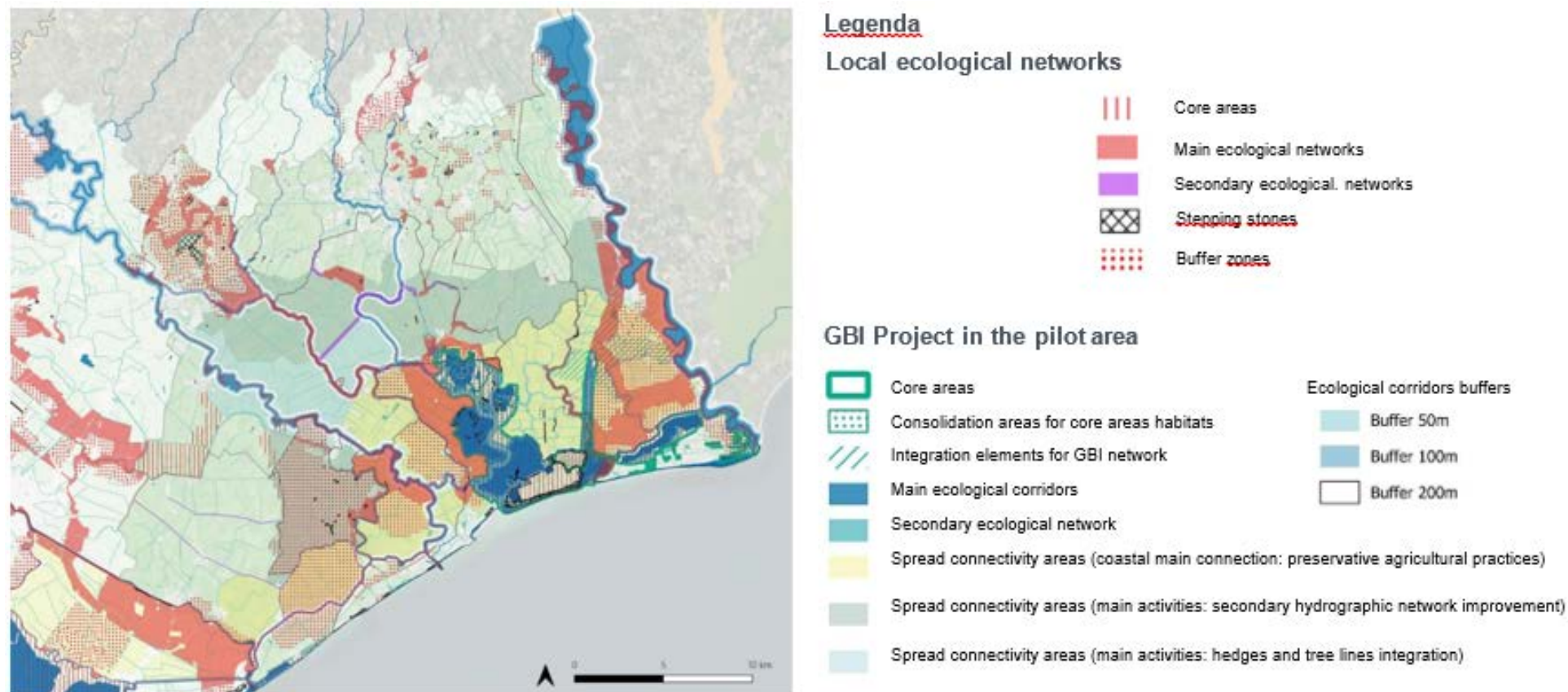


Figure 7 Overlay of elements of the Municipal Ecological Networks and GBI network project (source: authors)

Following the establishment of the Unified Legend, a proposal was developed for the cartographic redefinition of the Network Elements to ensure their uniform representation across the three Municipalities in the pilot area. The Network Elements identified in the municipal urban plans were converted, where necessary, into the reference categories of the Unified Legend.

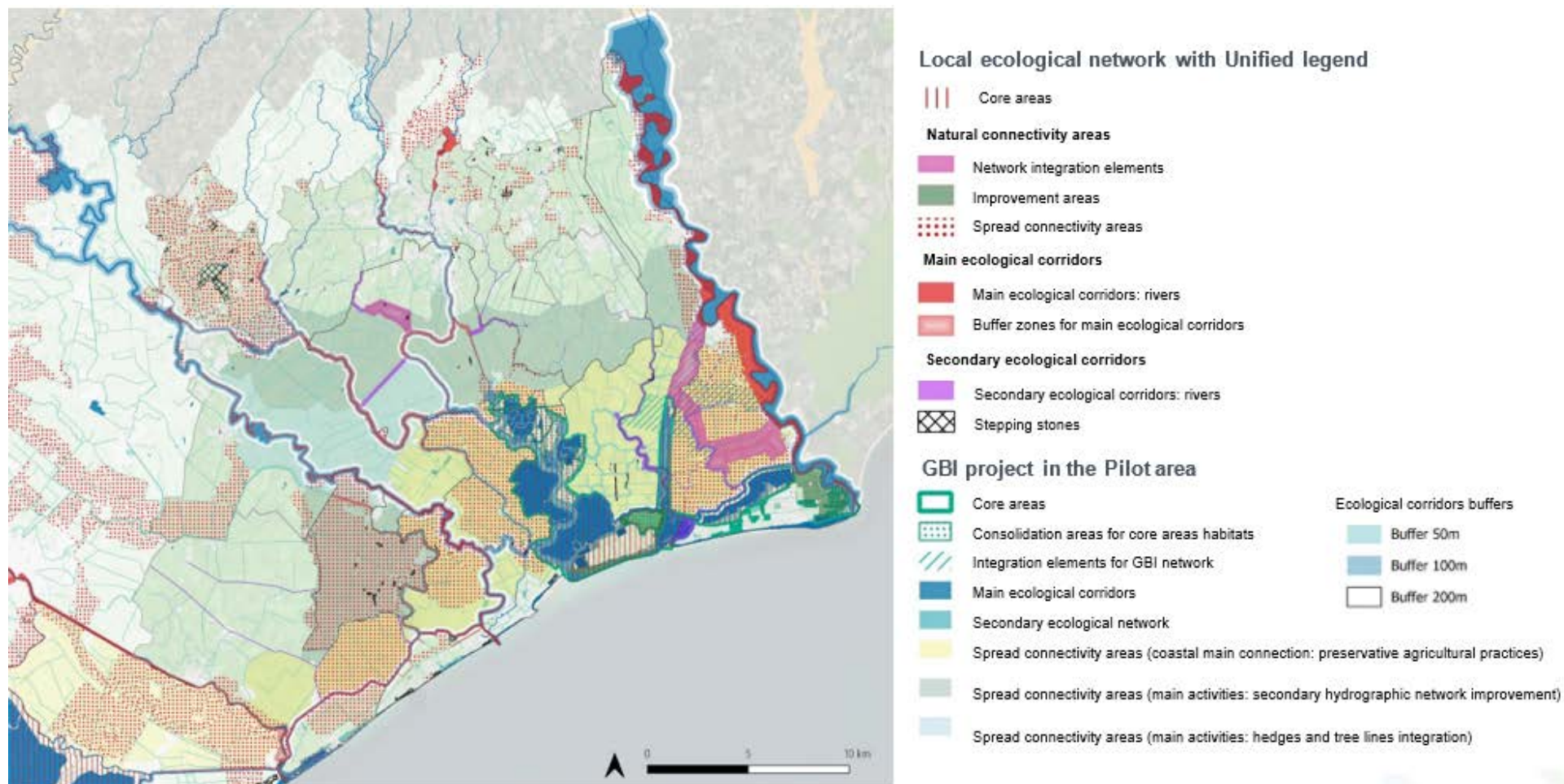


Figure 8 Proposal of Unified legend for the municipal ecological networks in pilot area (source: authors)

4.2.2 Municipal intervention plans. Normative Guidelines and Critical Nodes of the Ecological Network of the Pilot Area

In the ecological network plan of a municipality each component of the EN - such as core areas, ecological corridors, stepping stones, and critical passages - is described not only graphically in its spatial and functional dimensions (maps), but also in terms of the regulatory implications it entails (technical implementation norms providing guidance to the municipal intervention plan). Core areas are acknowledged as biodiversity reservoirs requiring strong and proactive conservation measures, including their enlargement and restoration when degraded or fragmented. Ecological corridors, both primary and secondary, are conceptualized as dynamic, linear ecosystems essential for the movement and genetic exchange of species. They are further articulated into riverine and terrestrial types, with specific provisions regarding their protection, management, and restoration - especially in relation to riparian vegetation and buffer zones.

The proposal underlines the importance of better integrating these into the PAT, by translating the GBI network project into municipal planning language and scales. This implies a clear recognition of functional ecological units, the mapping and safeguarding of critical nodes, and the identification of agricultural and forested areas where restoration or enhancement actions would increase the resilience and coherence of the network. Municipalities are thus encouraged to align their land-use plans and regulatory instruments with ecological functionality objectives, particularly through the adoption of measures that limit urban expansion, encourage regeneration of degraded areas, and support the multifunctionality of peri-urban and rural spaces.

A crucial aspect of the proposal of revision of the technical norms is the emphasis on nature-based solutions (NBS) as a planning and design approach to restore and create neo-ecosystems. These solutions include reforestation with native species, the restoration of riparian corridors, the creation of wetland patches, and the use of ecological engineering to stabilize banks or regenerate soil. Such interventions are not only effective in improving biodiversity and connectivity, but also provide priority ecosystem services such as water purification, carbon storage, and climate regulation.

Equally important is the attention devoted to enhancing biodiversity within agricultural and urban contexts. The proposal recognizes the value of traditional rural landscapes, particularly those rich in structural elements such as hedgerows, vegetated canals, and tree rows, and promotes the adoption of sustainable agricultural practices that reduce chemical input and protect groundwater. In urban and peri-urban areas along the coastline, the focus shifts toward reweaving fragmented green spaces into a coherent ecological matrix, capable of supporting species movement while improving the quality of life and environmental health.

Infrastructure remains among the greatest threats to ecological connectivity. For this reason, the proposal provides guidance on ecological compensation measures, particularly in cases where new infrastructure projects are likely to fragment habitats or interrupt corridors. In such cases, municipalities and planners are advised to implement mitigation strategies such as fauna passages, corridor reconnections, and habitat restoration, and to avoid any planning decisions that would further reduce the ecological permeability of the territory.

The analysis also identifies several critical nodes within the pilot area - points where connectivity is most at risk due to the presence of barriers, urban sprawl, or intensive land use. Through spatial overlay with infrastructure and settlement patterns, the proposal maps areas of fragmentation and highlights where targeted actions are necessary to re-establish functional ecological links. Two particularly sensitive zones are emphasized: the river Livenza entry point and the coastal corridor connecting Veneto with Friuli-Venezia Giulia - both of which serve as regional and transregional ecological arteries.

To guide prioritization of interventions, the proposal adopts the lens of ecosystem services. Areas with low ES provision - especially those related to habitat quality support, water regulation, and climate mitigation - are flagged as needing urgent restoration or enhancement. A specific annex provides a detailed assessment of each critical node, identifying which ecosystem services are lacking and what type of intervention could most effectively address these gaps.

In conclusion, the proposal provides not only a spatial and ecological vision for the future of the Caorle Lagoon system but also a clear regulatory and methodological path for integrating this vision into municipal planning. It brings together ecological science, territorial governance, and planning tools in a way that is both technically robust and sensitive to the socio-economic dynamics of the area.

4.3 Other planning instruments at regional level currently under revision or to be addressed in the future

As demonstrated by the case study, although the current planning framework of the Veneto Region includes ecological network plans (e.g., RER and REP), these instruments do not yet fully reflect the functional role of Green and Blue Infrastructure (GBI) nor systematically integrate Ecosystem Services (ES). In light of the ongoing and forthcoming legislative initiatives being led by the Department of Territorial Planning, there is a timely opportunity to advance the current ecological network planning framework. In particular, the upcoming revision of the regional law on Territorial and Landscape Planning foresees the development of thematic guidelines – the so-called “Planning Workbooks” – which offer a promising tool to operationalize these concepts. These workbooks could assist municipalities and provinces in aligning EN plans with GBI ecological objectives at Regional and transnational level, ensuring coherence across governance levels and spatial scales.

Two specific “Planning Workbooks” could be developed:

- Regional guidelines and operational tools for GBI and EN implementation in planning instruments
- Guidance on the use of ES in EIA

The instruments listed above represent both existing and emerging opportunities to strengthen the integration of GBI and ESs into spatial planning practices.



Moreover, embedding GBI and ES into Environmental Assessment procedures would allow for a more comprehensive evaluation of cumulative impacts, extending protection beyond core Natura 2000 sites to include priority ecological corridors and multifunctional landscapes. Overall - if properly coordinated - these tools could play a key role in mainstreaming ecological connectivity and nature-based approaches into territorial governance.

Table 4: Overview of 4 other planning instruments currently under revision or to be addressed in the future

Instrument	Mandatory/ Voluntary	Relevance for connectivity. Gaps or inconsistency	Proposal for implementing GBI and ES – Key content
Regional Territorial Coordination Plan (PTRC) (including the Landscape Amendment, under development)	mandatory	The PTRC, aligned with the Regional Development Programme (RDP), defines strategic objectives and directions for regional planning. It includes the Regional Ecological Network (RER), detailed at the provincial level. However, GBI and associated ES are not yet explicitly identified or mapped in the PTRC.	Proposals developed at the regional level include the mapping of GBI and related ES, and the identification of priority corridors. These outputs should be integrated into future updates of the PTRC and cascade into PTCPs and the PGTM, ensuring alignment with EN and GBI objectives.
Provincial Territorial Coordination Plans (PTCPs) and Metropolitan Area Territorial Plan (PGTM)	mandatory	PTCPs and the PGTM set out spatial planning objectives and include the Provincial/Metropolitan Ecological Networks (REP). However, REPs do not comprehensively include GBI and ES, and there is inconsistency across provinces in terms of structure and criteria.	Future revisions should incorporate regional GBI and ES mapping, harmonize ecological network criteria, and support cross-boundary connectivity. Alignment with regional-level guidance (e.g., planning workbooks) is recommended.
New Regional Law on Territorial and Landscape Governance (under review by the regional administration)	Voluntary	The current legal framework does not adequately address GBI and EN. The proposed new law offers a strong opportunity to embed connectivity, GBI and ES into the planning system and to improve implementation tools.	The law foresees the development of “Planning Workbooks”, including operational guidelines to support municipalities and provinces. The GBI/ES workbook should include: <ul style="list-style-type: none"> - Multifunctionality of connectivity areas - Typologies and pressures on GBI - Restoration and prioritization of ecological corridors - Integrated GBI/ES mapping for corridor design - Technical regulations for implementation and replication - Governance guidance for coordinated planning and management - Local adaptation and NBS integration
Environmental Assessment (EA) procedures including Appropriate Assessment (AA) under the Habitats Directive	Mandatory (for plans/projects affecting Natura 2000 sites or protected habitats)	AA is mandatory for interventions near core Natura 2000 sites. However, connectivity areas outside these sites are often excluded, and cumulative impacts are rarely assessed.	GBI and EN should be formally recognized within EA frameworks. Proposed tools (e.g., GBI/ES mapping and corridor prioritization) can support comprehensive assessments including: <ul style="list-style-type: none"> – Ecological corridors and multifunctionality – Habitat quality, carbon storage, water regulation, and purification – Systematic evaluation of cumulative effects

In conclusion, the integration of GBI and ES into territorial planning instruments - across all planning levels - represents a strategic step toward ensuring ecological functionality, landscape resilience, and long-term sustainability. The proposed updates and methodological tools offer concrete pathways to bridge existing gaps and promote coherent planning approaches. Moving forward, it will be essential to support institutional coordination, build technical capacity, and ensure that the principles of ecological connectivity are mainstreamed into future revisions of regional, provincial, and local planning frameworks.



5 ANNEXES

D2.5.1 Proposta tecnica ai comuni dell'area pilota

D2.2.1 Assetto di governance

D2.2.2 Piano di azione



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PlanToConnect

Mainstreaming ecological connectivity in spatial planning systems of the Alpine Space

Project partners:

Urban Planning Institute of the Republic of Slovenia (SI)
Veneto Region (IT)
ALPARC – the Network of Alpine Protected Areas (FR)
Asters, organisation for the conservation of natural areas in Upper Savoy (FR)
Eurac Research (IT)
ifuplan - Institute for Environmental Planning and Spatial Development (DE)
University of Würzburg (DE)
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